NICHOLAS STENO.*

[Read to the Medical Students of the St. Louis University.]

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The throng of the curious which day after day crowds the basilica of St. Lawrence at Florence rarely pauses in the vault beneath the fourth chapel to the left to read this inscription:

Nicolai Stenonis
Episcopi Titiopolitani
Viro Deo pleni
Quidquid mortale fuit, hic situm est.
Dania genuit Heterodoxum
Hetruria Orthodoxum
Roma
Virtute probatum sacris infulis insignivit
Saxonio inferior
Fortem Evangelii assertorem agnovit
Demum
Diuturnis pro Christo laboribus aerumnisque confectum
Suerinum desideravit
Ecclesia deflevit
Florentia sibi restitui
Saltem in cineribus voluit.
A. D. MDCLXXXVII.

Only few of those who tarry before the simple slab or who admire the marble bust by Vincenzo Consoni, which was placed in the basilica by the International Congress of Geologists in 1883, know that in the quiet tomb of the Medici one of the greatest scientists of the seventeenth century has now rested for more than two hundred years.

The visitor to the land of Hamlet, as he meanders through the Anatomie of the Copenhagen University, will be confronted by this picture of a Catholic bishop and wonder why a churchman has been placed among such strange company.

*This sketch is based upon the life of "The Dane, Niel Stensen," by William Plenkers, S.J., *Freiburg, 1884.*

Nicolaus Stenonis

We need not be surprised, however, at the general unconcern regarding the history of medical men when to the greatest number of those who daily pronounce the name of Steno, throughout all the lands in which anatomy is taught, it signifies little more than a short term by which custom designates the duct leading from the parotid gland into the mouth.

This duct has immortalized Steno, and were it his sole claim to distinction, it would be a sufficient reason for wishing to know something more of the man than only the name.

For medical men, his place in the history of anatomy is, of course, the most important, and with this alone we will concern ourselves. But let me say he was also a great geologist, a theologian thoroughly equipped and a controversialist of no mean order, whose labors in the interests of his church, of which he became a bishop, entitled him to higher estimate than Park accords when he designates Steno "a peripatetic converter of heretics."

Nicolaus Stenosis was born on the 20th of January, 1638, in Copenhagen. His father, Steen Peterson, and his foster father, John Stichman, were goldsmiths of high repute on account of their skill. His preparatory education, however acquired, must have been very thorough, for later in life he spoke and wrote Latin, German, Dutch, French, Italian and English, and was thoroughly familiar with Hebrew and Greek. He was especially fond of mathematics and would have chosen this department of learning for his life work had not circumstances directed it into other channels.

At eighteen, in 1656, he entered the University of Copenhagen, in which no department equalled that of medicine, and more particularly did the study of anatomy flourish. To this day the Danes are pardonably proud of the family of Bartholini, who not only taught at Copenhagen during the entire seventeenth century, but who gave an impetus to medical science through their illustrious pupils which reached far beyond their own century. When we recall the unfavorable conditions surrounding the study of medicine—the thirty years' war, the war with Sweden, the pestilence which raged so terribly in 1654 that the University was closed—we cannot help admiring the men who continued throughout all these vicissitudes in the service of science in Denmark.

It was customary for the student to choose one of the professors for his preceptor; Steno selected Thomas Bartholini, the

professor of anatomy, as his friend, philosopher and guide. Under his direction he began the study of anatomy and continued his other studies, especially mathematics and the languages.

The peaceful pursuit of science was ruthlessly interrupted by the invasion of Denmark by the Swedes in 1658, who besieged Copenhagen. A regiment of students, numbering two hundred and sixty-six, called "the black coats," on account of their dark clothes, was formed for the defense of the city; upon its roster we find the name of young Steno. During the day they were at work mending the ramparts, and the nights were spent in repelling the attacks of the enemy. In the course of this long siege, the city was compelled to cope with a more formidable enemy than the Swedes—famine with all its horrors—before relief came in the shape of provisions and reinforcements furnished by the Dutch fleet.

Throughout these turbulent days the student soldiers rendered valuable services to their country, and though it be true that *"inter arma silent musae"*—"the war gods do not favor the muses,"—it appears, nevertheless, that Steno attended the lectures and dissections which were conducted by the teachers in the intervals when the students were not on duty.

After a three years' course at the University of Copenhagen, the students usually repaired to foreign universities to complete their studies. Armed with a certificate from his preceptor, the Danish student presented himself at the school where he wished to continue his scientific pursuits. Thomas Bartholini furnished his student such a certificate and a letter of recommendation to Gerhard Blaes—or Blasius—at Amsterdam in Holland. Since the beginning of the seventeenth century, Amsterdam possessed especial attractions for Danish students, because the teaching of anatomy at the Dutch universities made them famous throughout Europe.

Steno became an inmate of the house of Dr. Gerhard Blasius. He had pursued his dissections but a few days under the direction of his new instructor, when he made that discovery in anatomy by which his name has been indelibly engraven on the tablet of fame—he discovered the duct of the parotid gland. This discovery involved Steno in so much controversy, which furnishes such interesting glimpses of the methods of the learned of those days, that it will not be out of place to follow this dispute somewhat in detail.

This was preëminently the era of controversy, because it was the era of many discoveries and therefore of much discussion.

Let us pause to enumerate some of the names with which we are so familiar to-day, and which belonged to the contemporaries of Steno: Bartholini, van Horne, Wharton, Sylvius, Malpighi, Des Cartes, Spinoza, Willis.

Steno narrates in his own modest, simple style how he made his great discovery, in a letter which he wrote on the 22nd of April, 1661, to his teacher, Bartholini:

"Since you request of me in your letter to publish a representation of the external salivary canal, I am induced to explain to you briefly the envy which this otherwise unimportant discovery has caused me, as also the lessons which I have learned from it, not in order to seek glory in little things but to refute the hated accusation that I am anxious to adorn myself with borrowed plumage. If the thing is viewed in the proper light, it is really not worth while to make a great ado about it. Long ago a similar canal was discovered.*

"Furthermore, Casserius has observed the canal in question but spoke of it as a muscle. But, since the crime of which I am accused, on account of this canal, does not permit me to remain silent, I shall relate to you as my teacher the whole story and leave the decision to your judgment.

"It is not a year since I was hospitably received by Blasius. He permitted me, at my request, to dissect with my own hand whatever I should purchase, and fortune so favored me that in dissecting in my study the first head of a sheep, which I had purchased on the 7th of April, I discovered a canal, which, so far as I know, no anatomist has as yet described. As I was just about to separate the well known tissues and then to dissect the brain, it occurred to me that I ought first to examine the vessels which surround the cavity of the mouth. Whilst examining for this purpose the veins and arteries, I observed that the point of my knife no longer wedged in between the tissues, moved more freely in a large cavity, and I soon heard as I drove forward the iron the sound it produced by striking the teeth. Astonished at this discovery I called the master of the house to get his opinion. He first ascribed the sound to the thrust of my knife, then he had recourse to explaining it as a 'freak of nature;' finally, he con-

*He refers to the English anatomist, Thomas Wharton. Adenographia: sive glandularum totius corporis descriptio. *Londini, 1656.*

sulted Wharton, but since this also did not help us, and since the vessels, which had not been very carefully handled, did not permit of further examination, I determined to again make the same examination but with greater care. I succeeded, though not so well as the first time, on the head of a dog."

In the same month Steno communicated his discovery to his friend, Jacob Henry Paulli, who in 1662 was made professor of anatomy at Copenhagen, and later to Francis Sylvius, who gained such great fame through his discoveries and descriptions of the brain and the glands, and whose name is so familiar to us in connection with a well known cerebral fissure. Sylvius found the duct in man. In a letter to Professor Eysonius of Groningen, the younger brother of Blasius credited Steno with the discovery. Not so thought Blasius. He became greatly enraged that Steno should arrogate unto himself a discovery which belonged to him. But instead of proof, he indulged in invective—"liar," "blasphemer," "malevolent fellow inflated with envy," are some of the choice epithets which he hurled at his opponent.

Steno continues: "Had not the celebrated Mr. van Horne given my name to that canal in so conspicuous a place, before such a circle of learned men, I should gladly have renounced my rights. But to proceed to other things, I shall mention one fact which I consider the most conclusive proof. Blasius shows plainly in his treatise 'De Medicina Generale' that he has never sought for the duct; for he does not give to it either the proper point of beginning or ending, and assigns to the parotid gland so unworthy a function, that of furnishing warmth for the ear, that were I not right certain to have shown him the duct, I should be tempted to assert that he had never seen it."

Bartholini sent this answer on the 10th of May: "Your assiduity in investigating the secrets of the human body as well as your fortunate discoveries are highly praised by the learned of our country. The fatherland congratulates itself upon such a citizen, I upon such a pupil, through whose efforts anatomy makes daily progress and our lymphatic vessels are traced out more and more. You divide honors with Wharton, since you have added to his internal duct an external one, and have thereby discovered the sources of the saliva concerning which many have hitherto dreamed much, but which no one has (permit the expression) pointed out with the finger. Continue, my Steno, to follow the path to immortal glory which true anatomy holds out to you."

Bartholini regrets the controversy which has arisen with Blasius, but does not think it necessary to admonish Steno to moderate himself since he knows his modesty and composure. "But you, my Steno," he concludes, "delve deeply into the study of anatomy so that you may rise happily to be an ornament to your country, which you may rest assured knows how to appreciate your merits."

These annoying experiences made his stay at Amsterdam disagreeable; besides, he had outgrown his teacher, and he therefore went to Leyden where Sylvius and van Horne taught. His antagonist followed him. Ole Borch, a fellow student of Steno's at Leyden, wrote to Bartholini on the 20th of March, 1661, that he had heard that Blasius ascribed the discovery of Steno to himself. "But," he added, "Steno will answer him, not on account of the glory which is attached to the discovery, but because Steno will not wish it appear as though he had misled Sylvius and van Horne, who have publicly called the duct 'Steno's Duct.'"

About this time Blasius had published his "De Medicina Generale," above spoken of, and although he admitted in it that in his treatise he had reported almost exclusively the discoveries of others, he expressly claimed for himself the discovery of the canal in dispute. This assumption Steno proceeded to refute. On the 6th and 9th of July, 1661, he conducted a splendid public debate, over which van Horne presided, which did great honor to a young man of only twenty-three. The first part of this discussion, which was afterwards published under the title "Discussion Concerning the Glands of the Mouth and the Vessels Which Proceed from it," treats of his discoveries concerning the glands and energetically refutes the assumption of the Amsterdam professor. This debate increased the bitterness of Blasius and he complains in a letter written on the 16th of July to Bartholini, that Steno ascribes to himself, regardless of propriety and in violation of the truth, a discovery the glory of which belongs to him—Blasius. It is characteristic of the small mind of Blasius when he complains that in two places Steno had called him John instead of Gerhard. "What can you expect of a man who does not even honor an antagonist, whose words he is about to criticize, with his proper name, although it be the name of his beloved teacher. Oh, what a contemptible spirit!" exclaims the high-minded Blasius.

Bartholini, although he did not openly take sides, answered Blasius on the 1st of September and called his attention to his

ridiculous behavior. "Your conscience," he wrote, "will tell you who is right in the matter." "Farewell," he concluded his letter, "and control yourself."

In the meantime Steno proceeded to examine the glands of the eye and reported his results on the 12th of September to Bartholini. In the same letter he refers to a pamphlet written by Deusing against his public disputation which he felt should not be left unanswered.

Concerning his vivisections he says, "I freely confess that it is not without horror that I inflict such prolonged torments upon these dogs." He finds justification for it, however, in the benefits which are derived from it, for he continues, "Since I see that many things must be looked into which on other grounds cannot be looked for."

Toward the end of his letter he remarks that up to now his investigations have not resulted in favor of the Cartesian philosophy. For, like many others, Steno became a follower of the "new philosophy" enunciated by Des Cartes. I quote from this letter: "The Cartesians praise the certainty of their philosophy; but I wish they would convince me of that which they hold to be perfectly true, that animals have no soul and that it is all the same whether you touch, cut or singe the nerves of a living animal or the ropes of a machine."

The hopes of Bartholini, who was justly proud of the success of his pupil, were realized. Thus he writes on the 10th of November: "Your fame is growing from day to day for your pen and your sharp eye know no day of rest."

Steno worked on conscientiously and made one discovery after another. In December he published a splendid treatise on the glands of the eye and of the vessels of the nose, and in the beginning of 1662 he published a collection of the observations he had hitherto made. With such a reputation based upon such discoveries it was not a difficult matter for Bartholini to get the ear of his King for Steno. "You may count upon the favor of the King, as well as the applause of the learned," wrote Bartholini. So modest was Steno, that he replied: "Although I know that every dissimulation is foreign to you yet I believe that you follow the custom of other teachers who praise the work of their pupils not as though it were worthy of praise, but only to encourage them."

During the early part of 1664, Steno had returned to Copenhagen after traveling about Europe for some time. The primary

reason for his return was the death of his foster father; secondarily, perhaps, he was prompted by the prospective appointment as professor of anatomy. Soon after his return he published his "Anatomical Observations Concerning the Muscles and Glands" which he dedicated to King Frederick III. His conception of the heart as a muscle created the greatest sensation. "The heart has been considered the seat of natural warmth," he said, "as the throne of the soul. Some have considered it as the soul itself. The heart has been greeted as the sun, as the king; but if you examine it more closely it turns out to be nothing but a muscle. Truly these men would not have been so greatly mistaken had they not preferred their imaginary principles to the results of examining nature."

"This observation," says a learned contemporary (in *Le Journal des Scavans,* par le Sieur de Hedovville, *Paris, 1665*), "overthrew a system to which medicine clung most tenaciously," and a century later the learned Von Haller did not hesitate to pronounce this volume a golden book which contained the rich seed for new discoveries.

Sprengel,* the medical historian, has this commentary: "The true structure of the heart was first announced by Steno in 1663, and thus the power properly appreciated which forces the blood into the arteries. To be sure Borelli assures us that he had seen the structure of the heart in 1657 with Malpighi at Pisa, but his work did not appear until 1680. Besides a writer of Alexandria, the author of the book concerning the heart, which is placed among the Hippocratic works, who expressly designates the heart as a strong muscle, all the ancient authors had considered the heart as a parenchymatous structure. Steno was the first to show that this organ is composed entirely of muscular fibers; 'which,' he said, 'are fleshy in the middle and tendenous toward the ends.' He asserted that the position of these muscular fibers is so various that some are circular, others straight, still others are obliquely bent and that in their various positions they are so twisted as to resemble the figure eight. He is of the opinion that these fibers are united for the most part in the cavity of the left heart; some terminate in the cavity of the heart itself, others encircle the apex of the heart and then return to its base. When he notified his teacher, Bartholini, of this discovery, that truly great

*Sprengel (Kurt). Versuch einer pragmatischen Geschichte der Arzneikunde. *Halle, 1801,* Vol. iv, p. 58.

man was so rejoiced that it is evident that he (Bartholini) appreciated the value of this discovery."

As an appendix to the work cited, Steno published two letters, the first to the Dutch physician, William Piso, in which he describes the dissection of a roach which had been made in the presence of Steno by Simon Paulli, the Canonicus of Aarhuusen, on the 21st of March, 1664, in which he furnishes a beautiful description of the pupil. And in the second letter, dated the 12th of June, 1664, and addressed to the celebrated Amsterdam anatomist, Paul Barbette, he describes the nourishment of the embryo in the egg.

In spite of his great success as an anatomist and the great reputation which he had achieved by his various discoveries, and although enjoying the patronage and friendship of so influential a man as Bartholini, his ambition to be appointed Professor of Anatomy in Copenhagen was not realized, for on the 29th of August a Royal decree gave the appointment to Matthias Jacobson. Steno lost heart; he left Copenhagen and arrived in Paris in the beginning of 1665, as appears from the following which the *Journal des Scavans* of the 23d of March, 1665, adds to the "Anatomical Observations of 1664":

"This learned Dane is at present in Paris, where he daily makes dissections in the presence of many inquisitive persons. He has also dissected in the 'Ecole de Medicine' and has won the admiration of all the world by his discoveries. He possesses the faculty of giving such a clear idea of his discoveries that one is compelled to agree with him and to wonder how they could have escaped all his predecessors in anatomy."

During his stay in Paris, his acquaintance with the celebrated Melchisedech Thevenot had the most far-reaching influence. Through him he gained admission to that circle of distinguished savants who gathered around Thevenot, and as we shall see later on, the recommendation of this learned man opened wide the doors for Steno during his travels in the Southland.

His discourse concerning the anatomy of the brain, which he delivered before a select circle of learned men in Paris, attracted much attention, and not only his contemporaries, but our own time acknowledge the importance of it for the development of the study of the brain. Daremberg* does not hesitate to pro-

*Daremberg (Charles Victor). Histoire des sciences medicales, comprenant l'anatomie, la physiologie, la medicine, la chirurgie et les doctrines de pathologie generale. *Paris, Baillière et fils, 1870.*

nounce it the beginning of the modern investigations concerning this organ.

This lecture exhibits the scientific fervor and quiet discretion of the investigator in so beautiful a light that it will not be amiss to quote from the introduction:

"Instead of promising you the gratification of your desire for information concerning the anatomy of the brain, I candidly confess that I know nothing about it. I wish with all my heart that I were the only one who is compelled to say it, for in time I could at least profit by the knowledge of others. And, indeed, it were fortunate for humanity if this part of our body, which is the most delicate and which is often the seat of such dangerous diseases, were so well-known as so many philosophers and anatomists imagine. But there are few among them who imitate the honesty of Mr. Sylvius. Although he has occupied himself with this subject, so far as I know, more than anybody else, yet he speaks of it as a matter about which there is much doubt. The number of those for whom nothing presents difficulties is undeniably by far the greatest. These persons who have a ready affirmative answer for everything will expound to you the history of the brain and the arrangement of the parts with the same certainty as though they had been present at the construction of this wonderful structure and had thoroughly comprehended the plans of its Great Architect.

Though the number of such persons is very great, and I need not concern myself with the views of others, I must express the firm conviction that they who seek thorough science will find little satisfaction in all that has been written about the brain. There is no doubt that it is the principal organ and instrument of the soul, with which *it* performs wonderful things.

"Upon its surface you observe many things which excite your admiration, but after you have penetrated more deeply you do not see anything at all; all that you may say is that you find there two substances, the one dark gray, the other white; that the white substance is continued to the nerves, which are distributed throughout the whole body; that the dark gray substance serves in some places as an envelope for the white and in other places it separates the white fibers from each other.

"If we are asked, gentlemen, what these white substances are, in what manner the nerves are united with the white substance, how far the nerves penetrate with their fartherest ends into the white substance, we have reached a point where we must confess

our ignorance lest we desire to increase the number of those who prefer to be admired by a credulous public.

"The art of dissecting the brain is equally unknown; as far as I am concerned, I believe that the best dissection would be made if we traced the nerve fibers through the substance of the brain, in order to see what course they take and where they end. It is true this method is very difficult so that I doubt whether we will ever succeed without very special preparations, for the substance is so soft, the fibers are so delicate that one hardly knows how to touch them without tearing them. Since, therefore, anatomy has not reached that stage of perfection which enables us to make a true dissection of the brain, we will not in future flatter ourselves, but will openly acknowledge our ignorance, otherwise we would at first deceive ourselves and later on others if we promised to show them the true structure of the brain."

After discussing the opinions of the ancients, he passes on to Des Cartes to show that his system concerning the brain does not agree in all things with experience. He then refutes the misconceptions of Willis concerning a double row of fibers in the corpora striata, describes accurately the position and structure of the pineal gland, and concludes that it cannot be competent to produce the movements which Des Cartes ascribes to it. He also condemns several figures in Willis' book as inaccurate and first describes the valve which covers the fourth ventricle, and he showed that the third ventricle is not continuous with the lateral ventricles.

In the fall of 1665 he traveled through southern France where Thevenot's recommendation secured for him the friendliest reception among the learned. In January, 1666, he was in Rome, as is attested by the letter which he wrote from that city to the English physician Croon, and which is preserved in the proceedings of the Royal Philosophical Society of London. In May of the same year we learn that he was still in Rome from a letter of Malpighi's. He subsequently repaired to Florence for the purpose of acquiring a more thorough acquaintance with the Italian language.

When Steno arrived in Florence, the ancient splendor of Tuscany was still greatly in evidence. The court of the Medici was the gathering place for the learned of all countries who visited Italy. The Grand Duke Ferdinand II, as well as his brother Prince Leopold, were the generous patrons and promoters of the

sciences and the following extract from a letter of the naturalist and poet, Francesco Redi, may be near the truth:

"You know that I have the honor to serve a court where gather the distinguished men from all parts of the world, who in their wanderings seek and bring the fruits of laudable effort and who are so friendly received upon their arrival in Florence that they imagine themselves transported to the mythical gardens of the Odyssey."

Steno was not only most kindly received, but on the recommendation of Thevenot and upon the proposal of the mathematician, Viviani, the pupil and companion of Galileo, the Grand Duke appointed him his body physician and assigned to him a pension and a residence. Besides this he received an appointment at the hospital of Santa Maris Nuova, which exists to this very day. It was founded in 1288 by Folco Portinari, the father of Dante's Beatrice.

Steno followed the court, which held residence now in Florence, now in Pisa, and now in Livorno. Upon these journeys he had abundant opportunity to make interesting discoveries and observations. A series of dissertations, which he sent to Bartholini, contained the results of his studies which enabled him to publish in 1667 his large epoch-making work concerning the muscles and concerning embryology and generation.

He had now reached the height of his fame. Denmark was anxious to have the young scientist fill the chair of anatomy in Copenhagen; the learned of Holland and France admired his discoveries; Florence was anxious to entwine his laurels in her own wreath of glory.

On the third of July, 1672, he returned to Copenhagen, and with him there reappeared for the "anatomical theatre" of Denmark's capital the golden days of Simon Paulli and Thomas Bartholini.

His eloquent inaugural address so thoroughly characterizes him as an impressive and conscientious teacher as well as a man of deep religious convictions that I cannot refrain from quoting some of its passages. After thanking King Christian V for his benevolence, he requests his hearers not to fasten their attention so much upon the words and the hand of the teacher as upon the wonders which he will show them in the works of the Creator. "The anatomist," he says, "must call attention to the hidden wonders of God in a similar manner as the guide who shows the treasures of a museum to visitors. At first sight nature often

offers little that is attractive; a cadaver, for example, can only appear repulsive, but we must not confine ourselves to externals, but endeavor to penetrate to the inner beauties. If you survey a meadow in the most beautiful season of the year from a distance, you gain a most lovely impression on account of the mixture of exquisite colors. When, however, you examine the individual plants and contemplate the leaves and flowers, there is unfolded before your eyes such a variety and beauty of structures and colors that you will be forced to exclaim: 'from a distance all this appears to be beautiful, but as we draw nearer its beauty is increased!' But if you proceed in your investigation and examine more closely a single plant, the interior construction of its parts, the course and movements of all the fluids and the series of changes which occur in the plant—since out of the seed is developed the plant and in turn out of it comes new seed—although you understand but little of these processes and see them only in a haze, yet you will know that the pleasure which you derive from that which you do understand is in no proportion to the pleasure which you would enjoy were you to comprehend all these mysteries.

"We possess the faculty of reason, by it we judge the things which fall under our senses, and reason opens a visible avenue by which we recognize the supersensible through the sensible. Far be it, therefore, from us that we lay aside human dignity and place ourselves among the animals. Let us rather consider and reflect often upon this great truth in order that we may progress from ignorance to knowledge from the imperfect to the perfect; then we shall engender in ourselves thoughts worthy of the true dignity of man. This is the truth to which I refer. If even the smallest part of the human countenance is so beautiful and fascinates the observer, what beauties would we not see, what pleasures would we not experience, if we could thoroughly understand the entire wonderful structure of the body; if we could understand the soul to which are subjected so many and such ingenious instruments, and if we could understand the dependence of all these parts upon the Cause which knows everything that we do not know.

"That is beautiful which we see; what we know is still more beautiful, but the most beautiful things are beyond our knowledge.

"It is the true, higher object of anatomy to direct the beholder through the astonishing structure of the body to the dignity of the soul, and finally to lead him through the wonders of

both to the knowledge and love of the Creator. For who could contemplate the wonderful structure of the human organism without ever inquiring as to its author? Concerning Him we learn the more, the more humble and unprejudiced we wander through the immense forest of anatomical observations. On beholding a statue or a picture we ask 'who is the master?' How much more must we make this inquiry when examining the structure of the human body? Futile and beneath the dignity of science are the efforts of those who would make a handmaid of anatomy to prevent or cure diseases.

"That is true anatomy through which we at first gain a knowledge of the animal body and afterwards a knowledge of God. Therefore, the anatomist must not ascribe his discoveries or proofs to himself—he only presents the work of God who not only observes him but helps him. Should you observe anything worthy of your expectation, I would ask all of you to praise with me the Divine goodness and to ascribe all my mistakes, both of the tongue and of the hands to my impatience or to my concealed pride."

His closing sentences are especially indicative of the character of Steno: "In refuting the errors of others I shall be exceeding chary as I recall to mind the words of wisdom spoken by a most honorable man. 'The knowledge of the truth,' says he, 'is fully competent to bring to trial and to overturn all false opinions even those formerly unheard of.'"

As early as October, 1672, Steno performed public dissections for some of which Griffenfeld, the prime minister of Christian V, furnished a pair of reindeers, and Terlon, the French ambassador, a bear.

The University of Copenhagen did not, however, enjoy long the good fortune of seeing her young medical men gather around this distinguished teacher. He became involved in a religious controversy and perhaps finding the tenure of so conspicuous a position very precarious for one of his religious faith, perhaps also because he longed to return to his new home in sunny Italy, whatever motives actuated him, he resigned in 1674 and returned to Florence, and forever bade farewell to anatomy to devote himself to the church.

It is proper, therefore, at the conclusion of his career as a scientist to review the services he rendered anatomy. Steno's studies and investigations as an anatomist occurred during a time rich in discoveries and rich in distinguished representatives of

this department. Such, however, was the general prejudice against the study of anatomy that it was looked upon with contempt and considered shameful. When Steno directed his attention to its study, Harvey, the celebrated discoverer of the circulation, had just died; Bartholini the older, the first founder of an anatomical museum, was engaged principally with the examination of the lymphatics. In Holland, Steno was associated with van Horne and Sylvius, in France with Swammerdam, in Italy with Marcello Malpighi. Such associates must have stimulated greatly his natural capacity for the study of anatomy, which was fully recognized by his associates. Leibnitz and Von Haller added their favorite judgment of his work to the encomia of his contemporaries. Häser says of him: "Steno, of Copenhagen, the most illustrious pupil of Thomas Bartholini, is one of the most deserving anatomists of the seventeenth century. He was properly considered one of the greatest discoverers of his time; there is scarcely a part of the human body the knowledge of which he did not enrich."

It is true, as Hyrtl has pointed out, that during the time anatomy enjoyed more careful and solicitous attention than ever before, and that therefore great discoveries were the order of the day. Nevertheless, the history and controversy concerning "the duct of Steno" show clearly that even during that time more was required to make such findings than merely to root about in dissecting material. Zeal alone is not sufficient. Independent conceptions are necessary to become a discoverer. The anatomists of that day did not prosecute their studies with singleness of purpose, and were much hindered in their work by public prejudice. Dissections of the human body occurred comparatively infrequently everywhere. In Denmark, Anders Christiern was obliged to forego the dissections of human bodies because persons of refinement refused to eat at the same table with him, and Thomas Bartholini always gave notice of a dissection by the following grandiloquent announcement, which suggests that it was no ordinary occurrence:

"To mortals all a gladsome greeting of good fortune!"

"By the favor of the Supreme Diety, at the request of our benign King, with the approval of our illustrious Chancellor and with the consent of our eminent Lord Rector and the medical faculty, Th. Bartholinus D. & P.P., entering upon the dissection of a masculine human body, to-morrow (the day of the year), at 1 P.M., and intending to continue on subsequent days if God

good health vouchsafe, doth hereby with utmost courtesy and all insistent grace invite the scholars of all classes to behold and to attend as critical observers this spectacle, in which those will agreeably partake who recognize themselves as mortal men, and in this knowledge glory; those also who engaged in the noble study of Anatomy, esteem themselves and find pleasure in the majesty of their bodies."

The opportunities of Steno, as we learn from his letters, were confined to the occasional dissection of the body of a criminal and for the most part he had to content himself with the examination of animals. He nevertheless recognized the nature and structure of numerous glands and blood-vessels, the structure of muscles and above all of the heart muscle; his lecture on the brain discloses great familiarity with it, so that we cannot deny that he had a magnificent comprehension of the anatomical knowledge of his day and surpassed it in many things. Although he did not properly interpret the mechanics of muscular contraction, he nevertheless correctly pointed out that the action of the muscles does not depend upon an increase or loss of their substance. His recognition of the heart as a muscle, next to the discovery of Harvey, was the greatest advance in our knowledge of this organ and the great Bartholini thus comments upon it: "Remarkable indeed, are the opinions you broach concerning the heart and muscles. The shade of Hippocrates will sing paeans to thy honor, because by your excellent lucubrations you have revived the now abandoned theory of Coi concerning the heart and have demonstrated before our very eyes that beyond all doubt the heart is a muscle."

His dissertation on the structure of the brain suggests his importance in the study of that organ, and on various occasions we find that embryology has been very profitably touched upon by this remarkable man.

But more important than his discoveries in anatomy are the objects and methods of his investigations. Steno clearly tells us that the advancement of medicine must rest upon an anatomico-pathological foundation. In pursuing the correct course, he was stimulated by the opinions of Des Cartes, according to which we must look upon the human organism as a kind of mechanical apparatus which is composed of individual organs. And although he was far from considering the organism as a mere machine, nevertheless, he saw clearly the great benefits that would accrue from applying the laws of physics and mechanics to anatomy.

Perhaps his greatest characteristic as a man was his lovable modesty. His opponents accused him of not being well read. To a degree this is true, but like the great John Hunter, he preferred his own *observations* to the *opinions* of others.

Steno's anatomical works are:

Disputatio de glandulis oris et vasis inde prodeuntibus nuper observatis praeside D. Joh. van Horne habita. *Lugd. Batav., 1661, 1662.*

De glandulis oculorum novisque eorundem vasis observationes anatomicæ cum appendice de narium vasis. *Ibid., 1661, 1686; Genev., 1689.*

Observationes anatomicæ, quibus varia oris, oculorum et narium vasa describuntur novique salivæ, lacrymarum et muci fontes deteguntur et novum Bilsiide lymphæ motu et usu commentum examinatur et rejicitur. *Ibid., 1662.*

Responsio ad vindicias Hepatis redivivi contra Deusingium. *Ibid., 1662.*

Apologiæ prodromus, quo demonstratur, judicem Blasianum et rei anatomicæ imperitum esse et affectuum suorum servum. *Ibid., 1663.*

De musculis et glandulis observationum specimen, cui accedunt duæ epistolæ de rajæ anatome et de vitelli in intestina pulli transitu. *Hafn.* et *Amstel., 1664; Lugd. Batav., 1683.*

Elementorum Myologiæ specimen seu musculorum descriptio geometrica, cui accedunt canis Carchariæ dissectum caput et dissectus piscis ex canum genere. *Flor., 1667; Amstel., 1669; Genev., 1685.*

Discours de M. Stenon sur l'anatomie du cerveau. *Paris, 1669, 1732.*

Diss. de cerebri anatome, spectatissinis viris d. d. Societatis apud dominum Thevenot collecta dicata, atque e gallico exemplari Parisiis editio au 1669. Latinitate donata, opera et studio Guidonis Fanoisii. *Lugd. Bat., F. Lopez, 1671; Genev., 1685.*

De vitulo hydrocephalo epistola ad. S. Magn. Etrur. Duc. Ferd. II (Oenipont. 1669) ex Ital. in Latin. translata a D. Mtth. Motthio. *Acta Hafn.,* vol. II; *Genev., 1685.*